



# **OLTP + OLAP ftw!**

QCon San Francisco

November 8, 2016

# ABOUT ME

- Developed web apps for 5 years including e-commerce, business workflow, more.
- Worked at Google for 8 years on Google Apps, Cloud Platform
- Technologies: Python, Java, BigQuery, Oracle, MySQL, OAuth

**ryan@neo4j.com**  
**@ryguyrg**

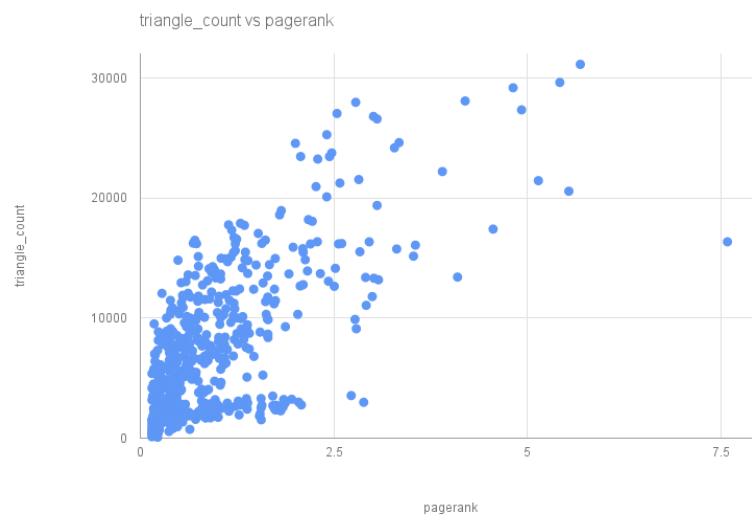
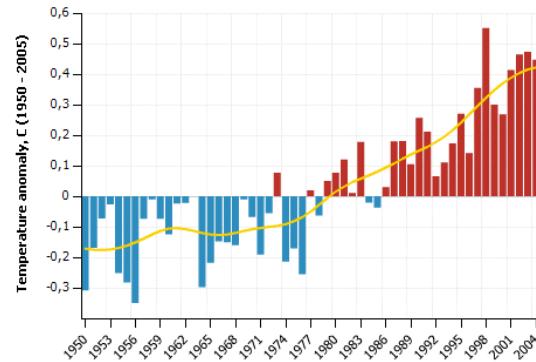
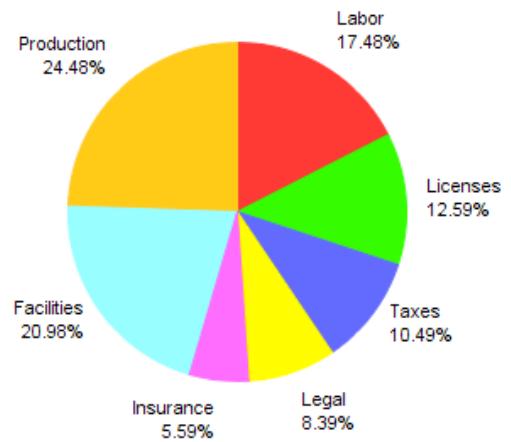


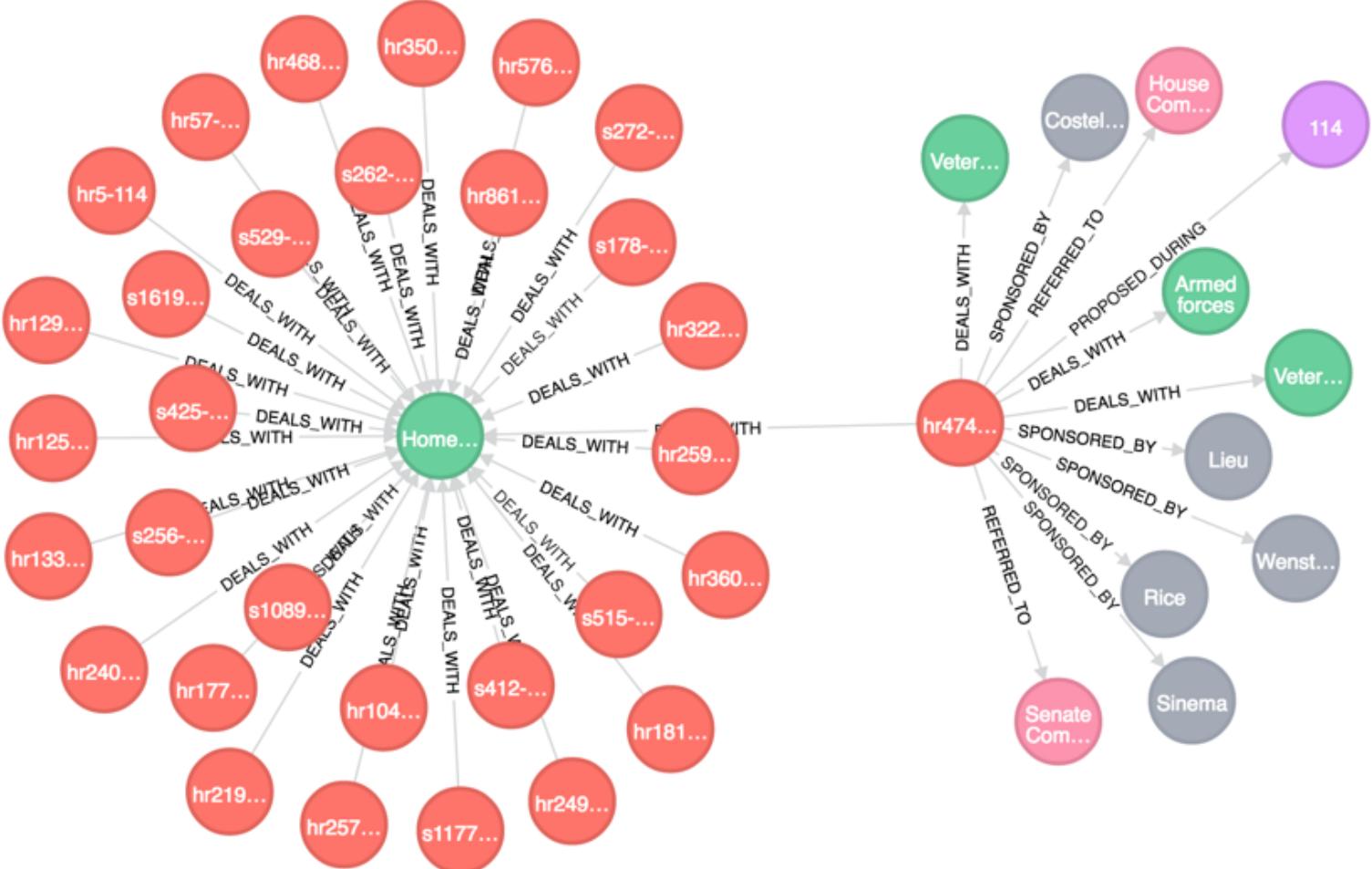
# Talking about Today

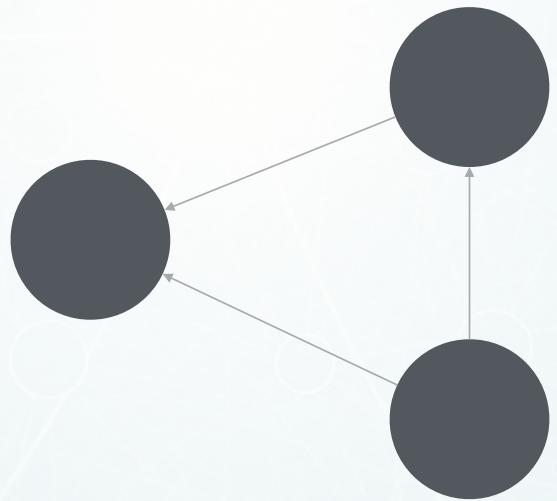
- **Quick intro to Graph DBs**
- **How Analytics works with Neo4j - then, now, and soon!**
- **Our patriotic duty to combine the two**



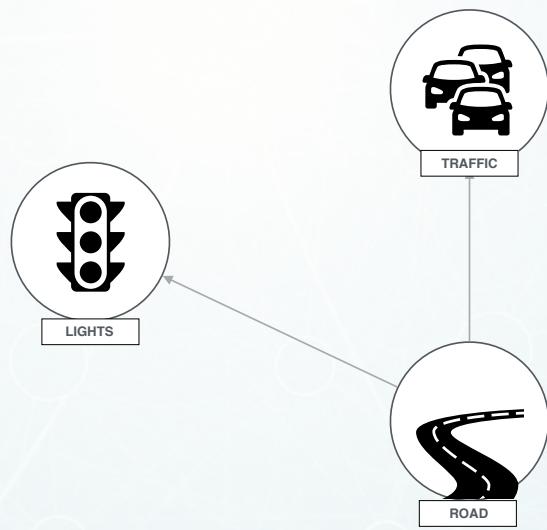
# **What is a Graph?**



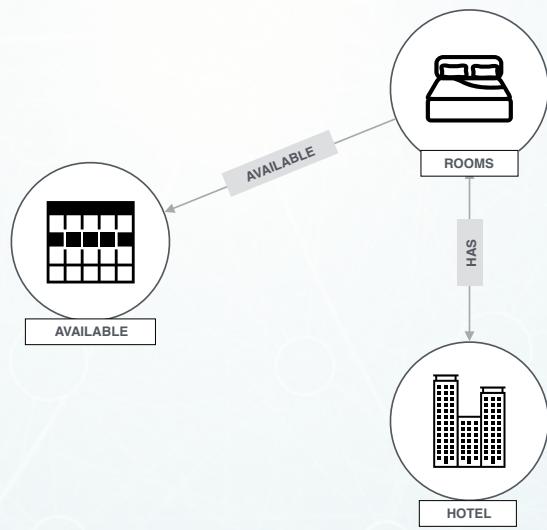




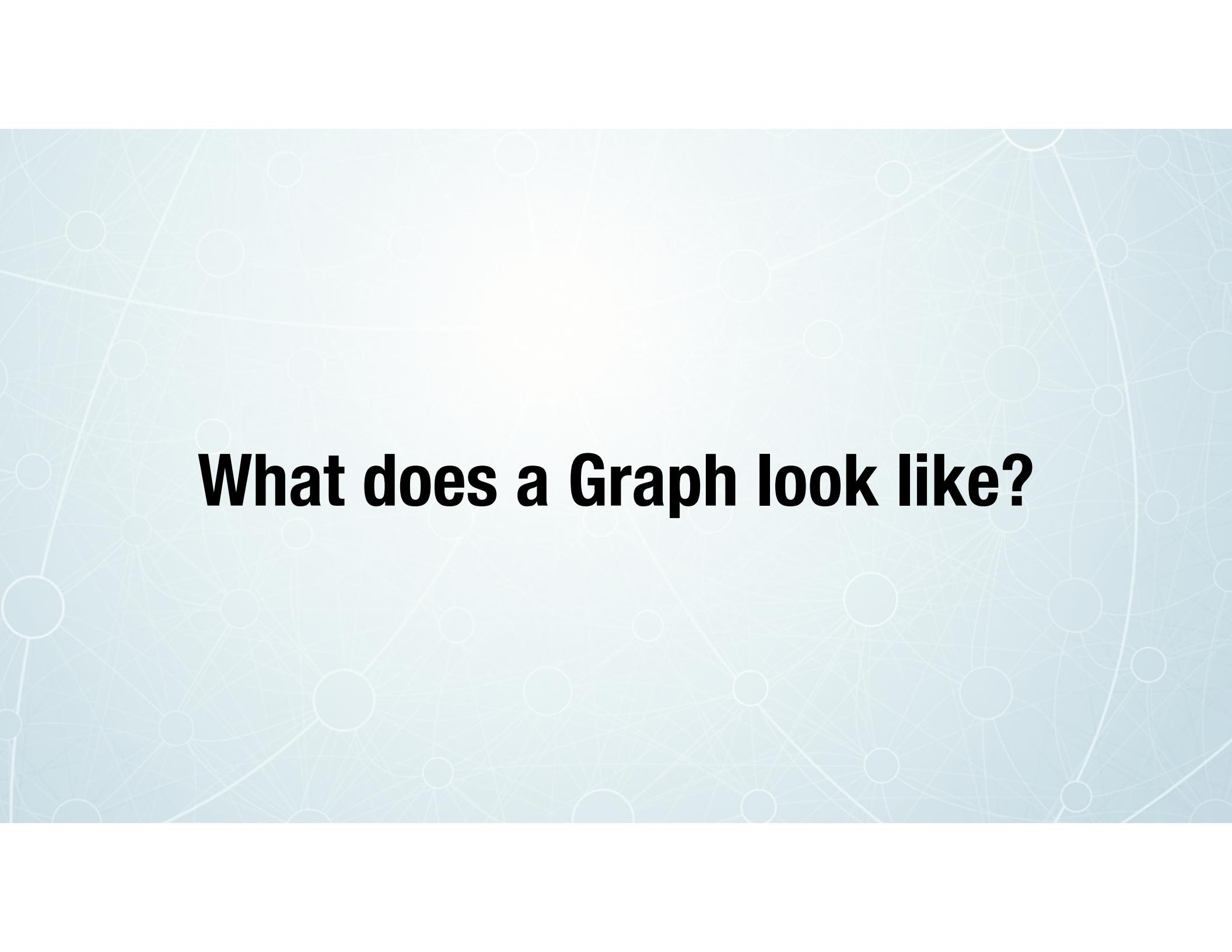
# A Graph Is Connected Data



# A Graph Is Connected Data

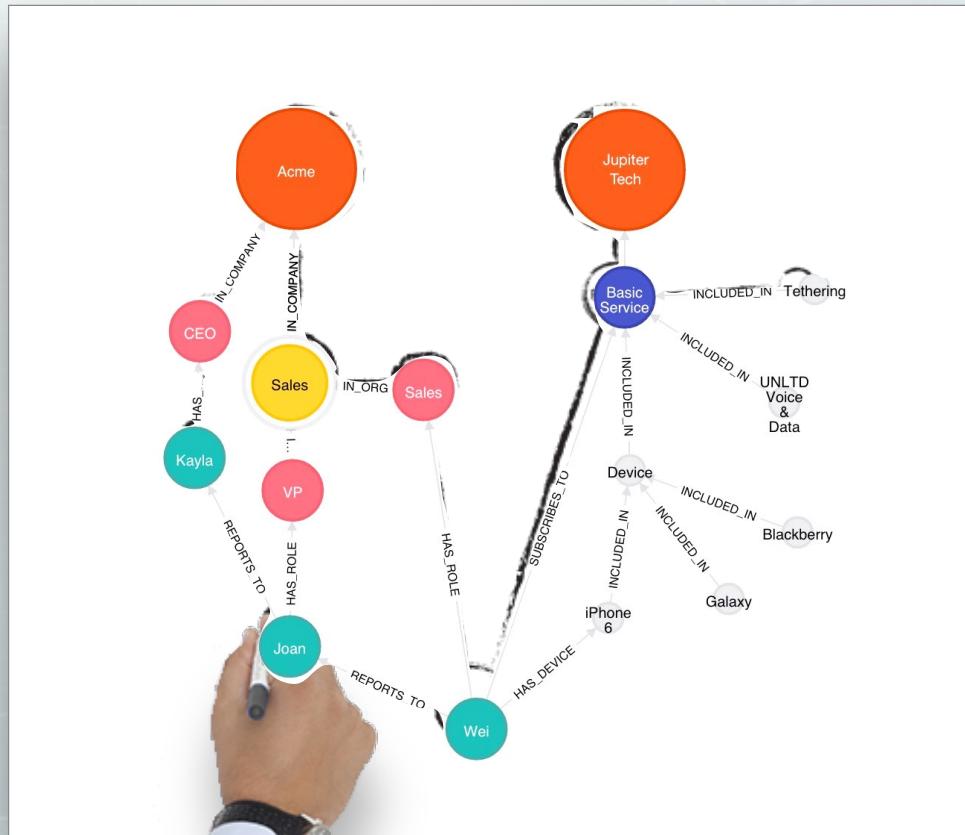


# A Graph Is Connected Data



# **What does a Graph look like?**

# Whiteboard Model is the Physical Model



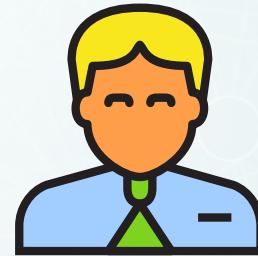
# Graphing Love



Ann



Loves



Dan

# Property Graph Model



NODE



NODE

CREATE (:Person { name:“Ann”} ) - [:LOVES]-> (:Person { name:“Dan”} )

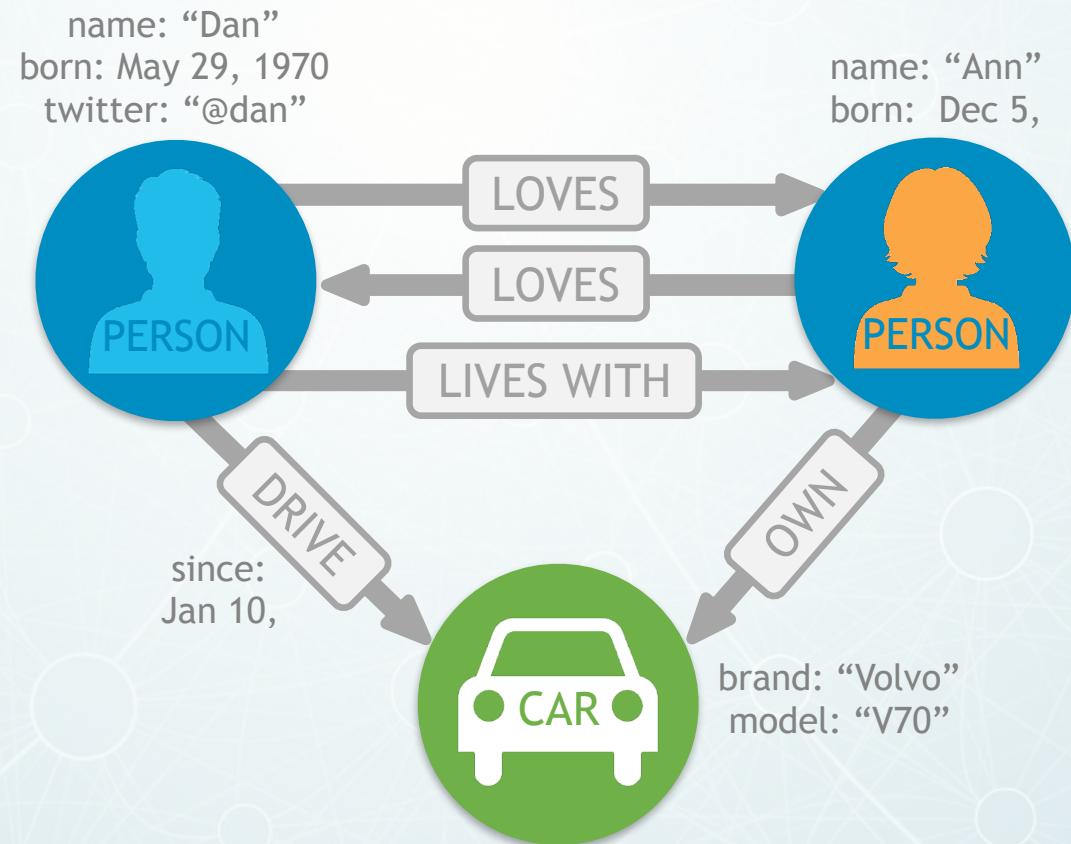
LABEL

PROPERTY

LABEL

PROPERTY

# Property Graph Model: Extended





# **GRAPHS FOR OLTP**

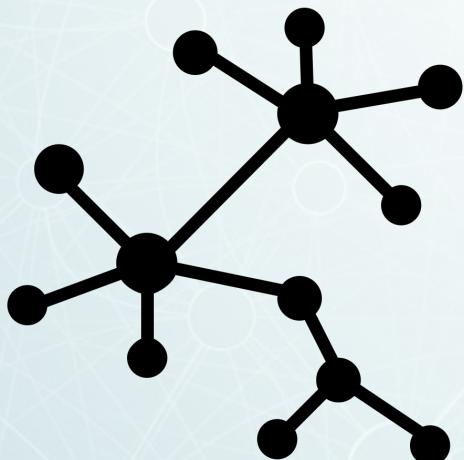


# **Intuitivness**

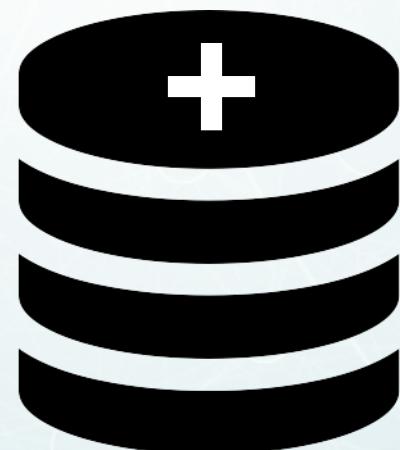
## **Speed**

## **Agility**

# What about Neo4j?



**CREATE MODEL**



**LOAD DATA**



**QUERY DATA**

# CYPHER!!!!

(Graphs) -[:ARE]->(Everywhere)

# How do you Query?



localhost:7474/browser/

## Neo4j 2.3.0

**Node labels**

- \* Category Customer
- Employee Order Product
- Supplier

**Relationship types**

- \* PART\_OF PRODUCT
- PURCHASED REPORTS\_TO SOLD
- SUPPLIES

**Property keys**

- \_GA\_TIMER\_MODULE\_NR address
- categoryID categoryName city
- code companyName contactName
- contactTitle country created\_at
- customerID customerName
- description discontinued distance
- employeeID favorites fax
- firstName followers following
- homePage id id\_str lastName
- location method name nodeRank
- orderID phone picture
- postalCode productId
- productName profile\_image\_url

\$ MATCH (e:Employee)<-[::REPORTS\_TO]-(sub:Employee) OPTIONAL MATCH (e)-[]-(o:...)

Graph Rows Code

\*(32) Employee(2) Order(30)  
 \*(31) REPORTS\_TO(1) SOLD(30)

Displaying 32 nodes, 31 relationships (completed with 31 additional relationships). AUTO-COMPLETE ON

\$ MATCH (e:Employee)<-[::REPORTS\_TO]-(sub:Employee) OPTIONAL MATCH (e)-[]-(o:...)

Graph Rows Code

\*(22) Employee(2) Order(20)  
 \*(21) REPORTS\_TO(1) SOLD(20)

How do you use Neo4j?

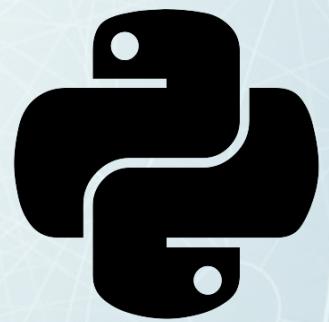


# Official Language Drivers

**JS**



**N**



# Community Language Drivers



**php**

# Extending Neo4j





**John Resig**   
@jeresig



Following

Really digging @neo4j. What use to be a bunch of complicated analysis scripts are now a handful of simple Cypher queries.

 Reply  Retweeted  Favorited  More

RETWEETS

38

FAVORITES

31





**David Meza**

@davidmeza1



Following

i love Neo4j because i can explore relationships faster than you can say sql join #neo4joy

RETWEETS

2

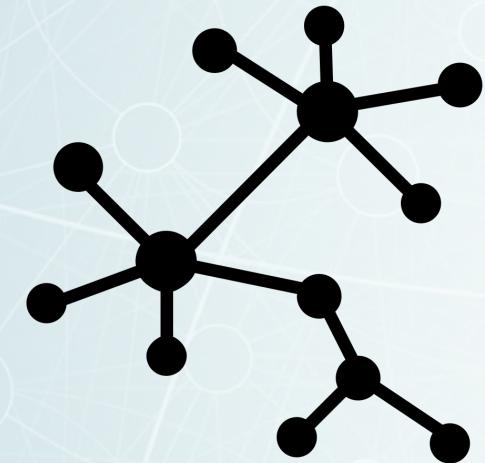
LIKES

7

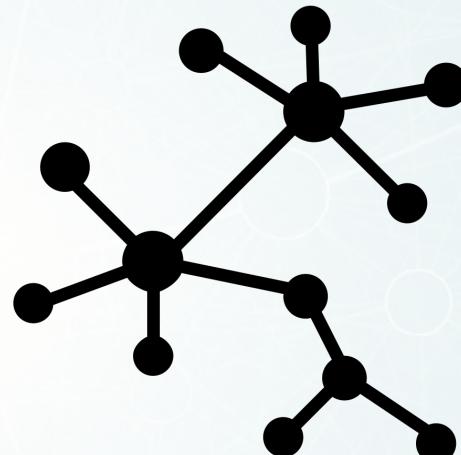


11:33 AM - 7 Dec 2015

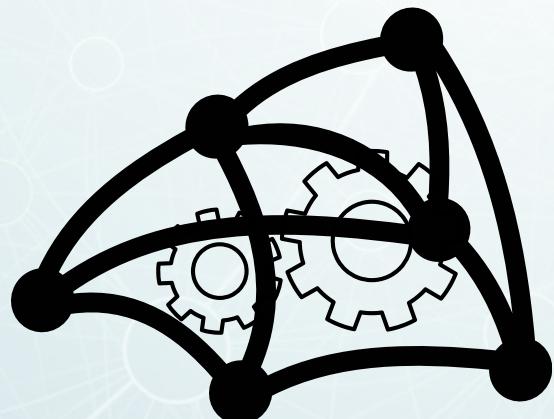
# **GRAPHS FOR ANALYTICS**



(1) DATA IN GRAPH



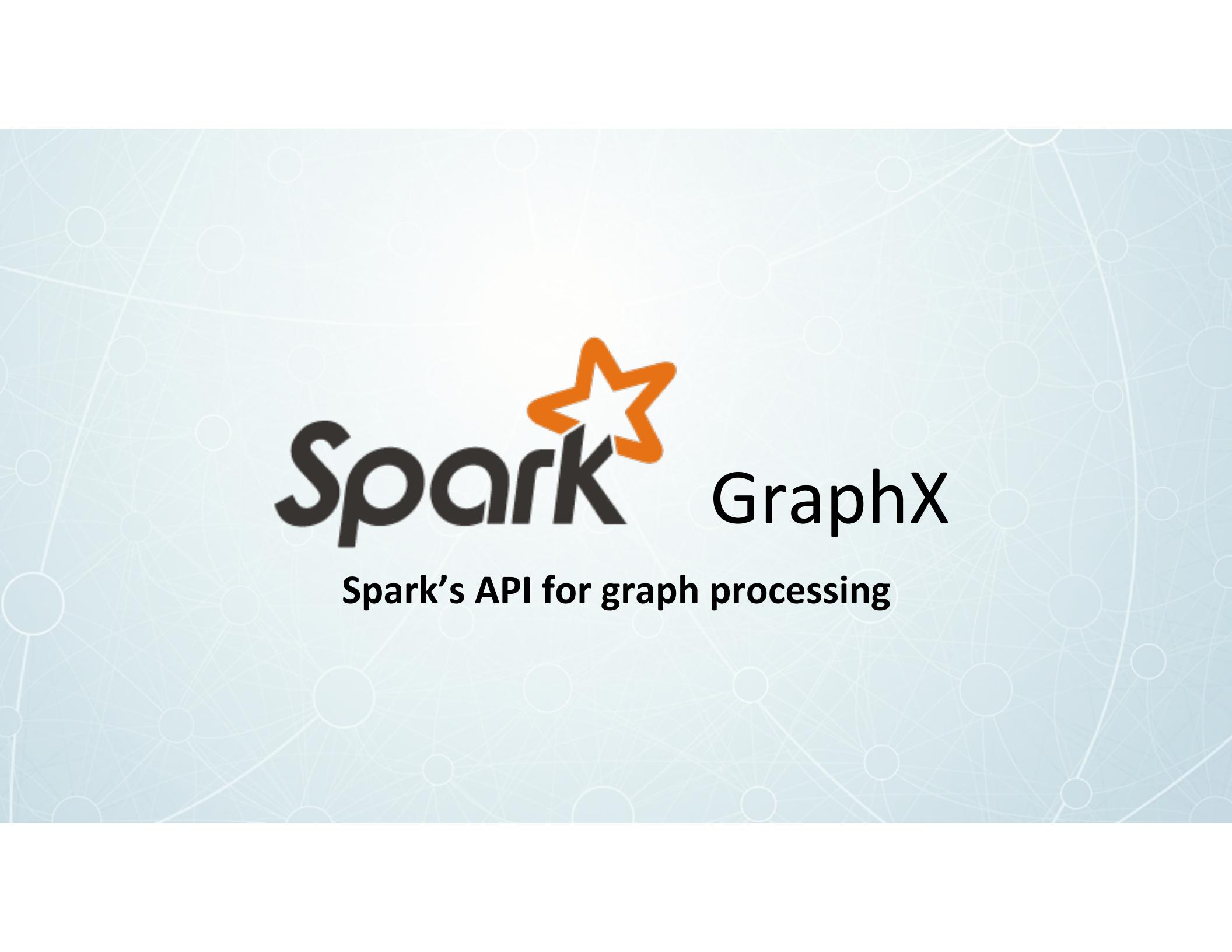
(3) RESULTS IN GRAPH



(2) ANALYZE RELATIONSHIPS

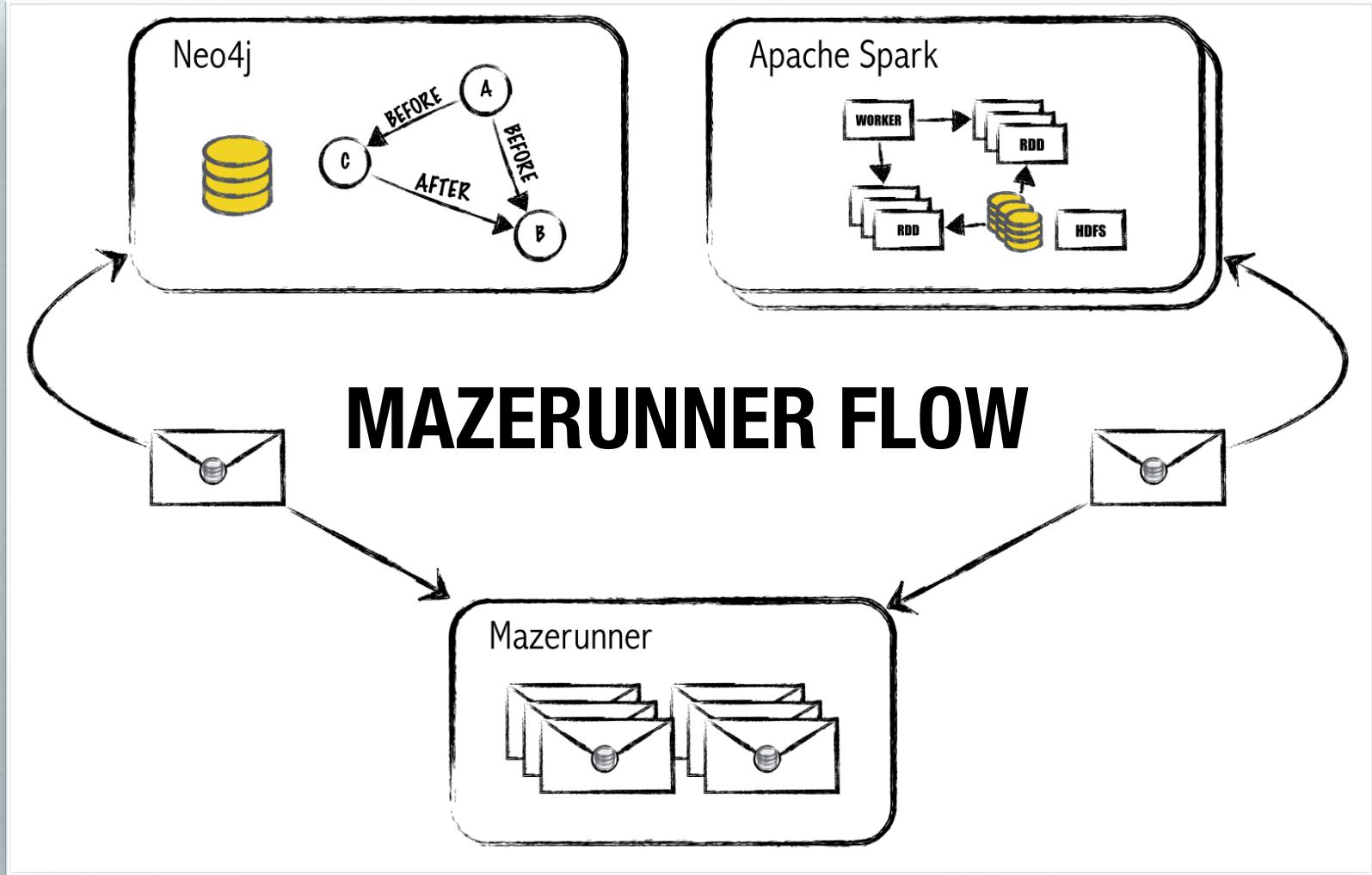


(4) QUERY GRAPH



# Spark GraphX

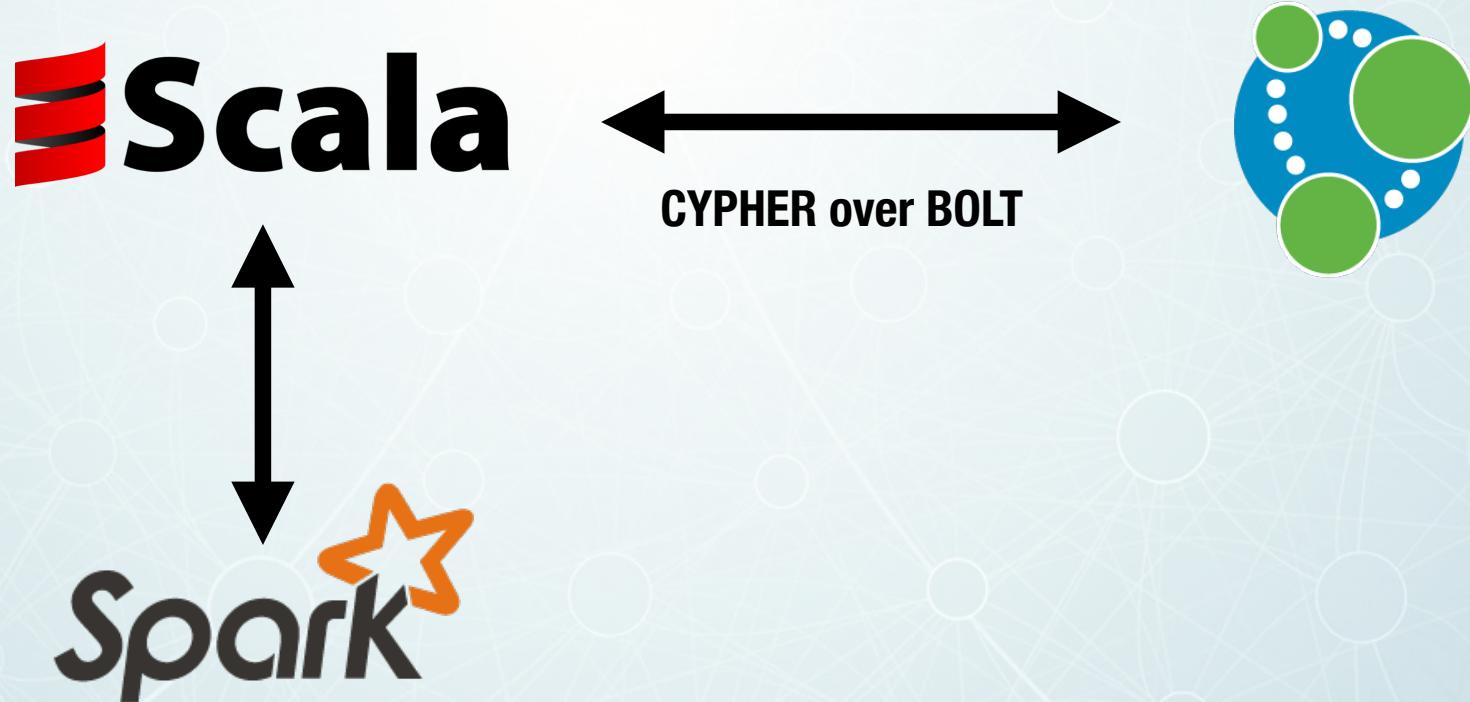
Spark's API for graph processing

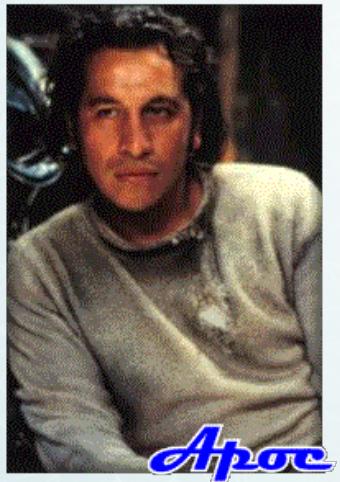




## NEO4J SPARK CONNECTOR

# Neo4j Spark Connector

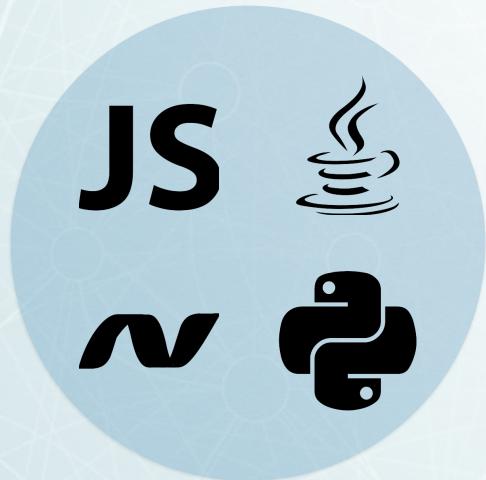




# APOC Library

*APOC*

# APOC Library



CYPHER over BOLT





**Guillermo Szeliga**

@gszeliga



Follow

I can't believe that @neo4j is actually real.  
Seems like a dream come true

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---

1  
RETWEET

3  
FAVORITES





# **GRAPHS FOR RECOMMENDATIONS**



The main product

Related products

People who bought X  
also bought Y

## Recommendations (In Real-Time)

**SUPERSHOP**



**Kitchen Aid Empire Red Stand Mixer** **\$219.99**

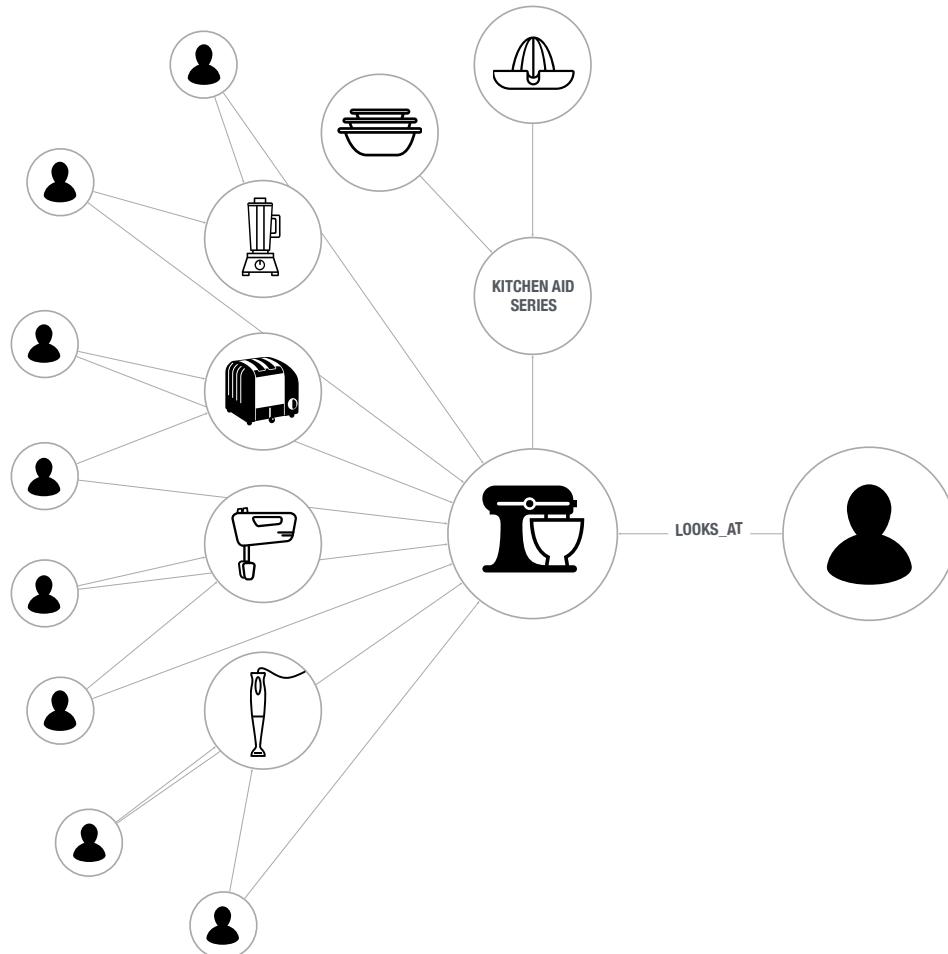
★★★★★ (14 reviews) + ADD TO CART

Frequently bought together:

 <b>\$44.99</b> RVSA Rotor Vegetable Slicer/Shredder ★★★★★ (14 reviews)	 <b>\$30.99</b> KPRA 3-piece Pasta Roller and Cutter Set ★★★★★ (14 reviews)	 <b>\$200.99</b> KSM1APC Spiralizer Attachment ★★★★★ (14 reviews)
---	---	---

People who bought this item also bought this:

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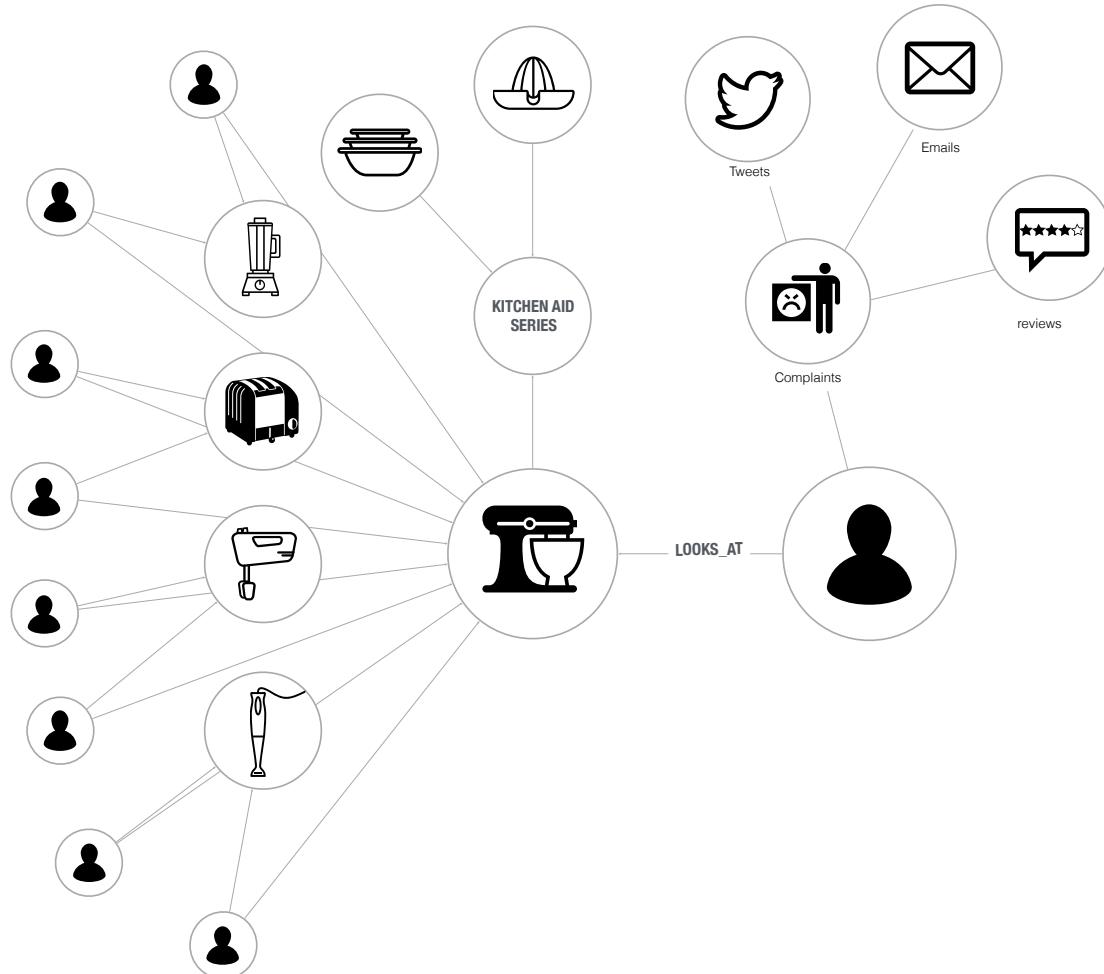
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≡ SUPERSHOP Cart +



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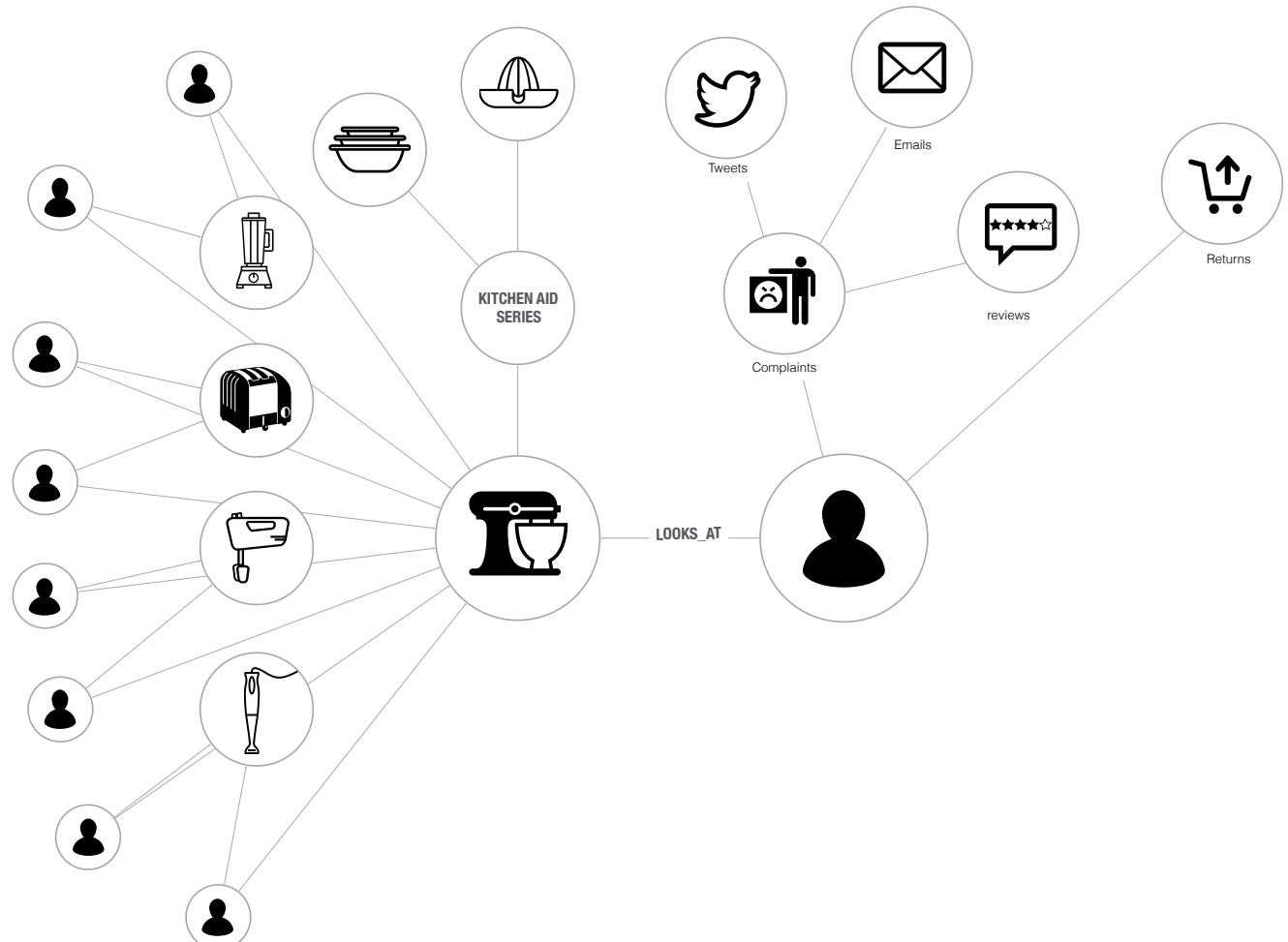
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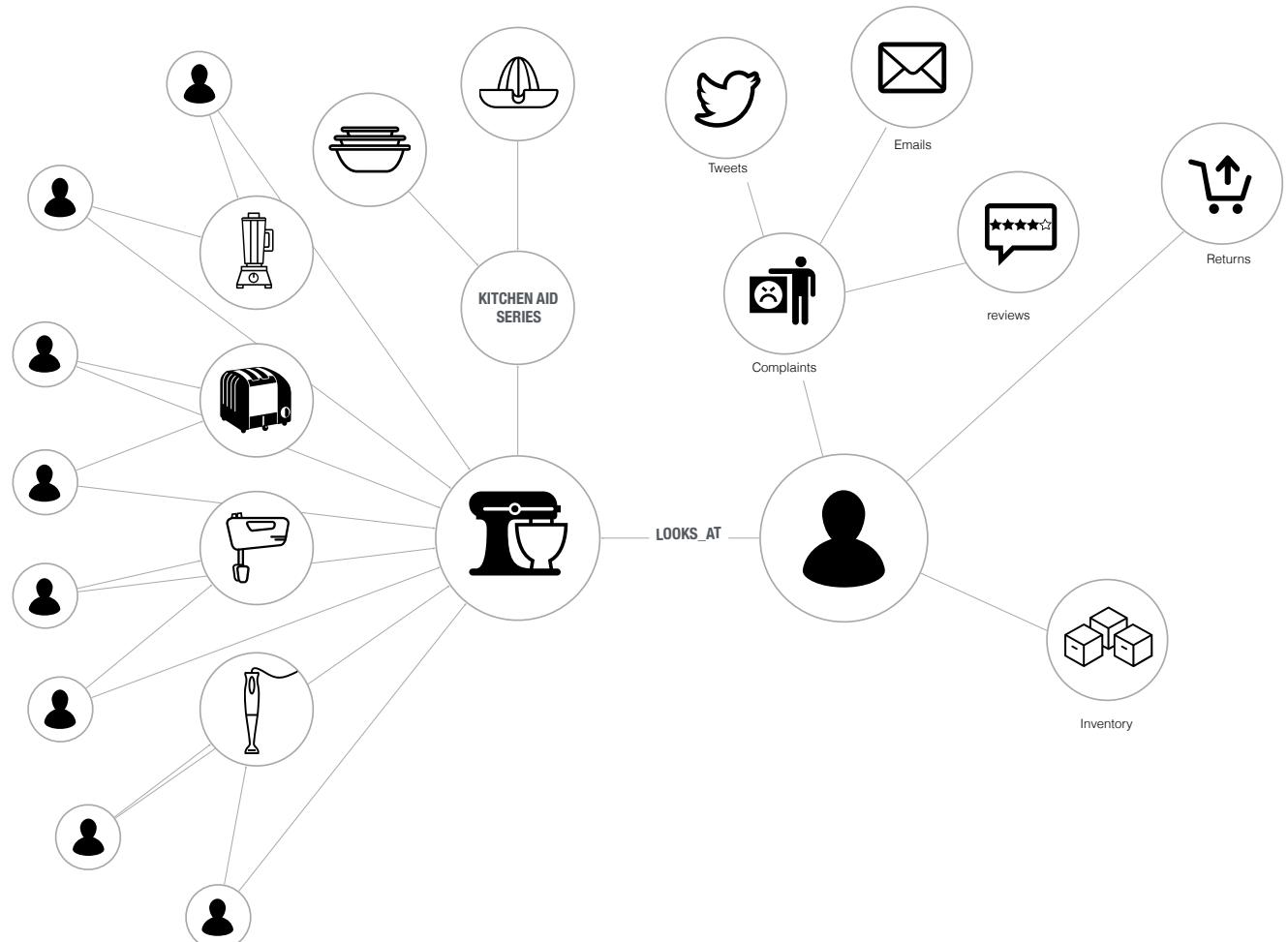
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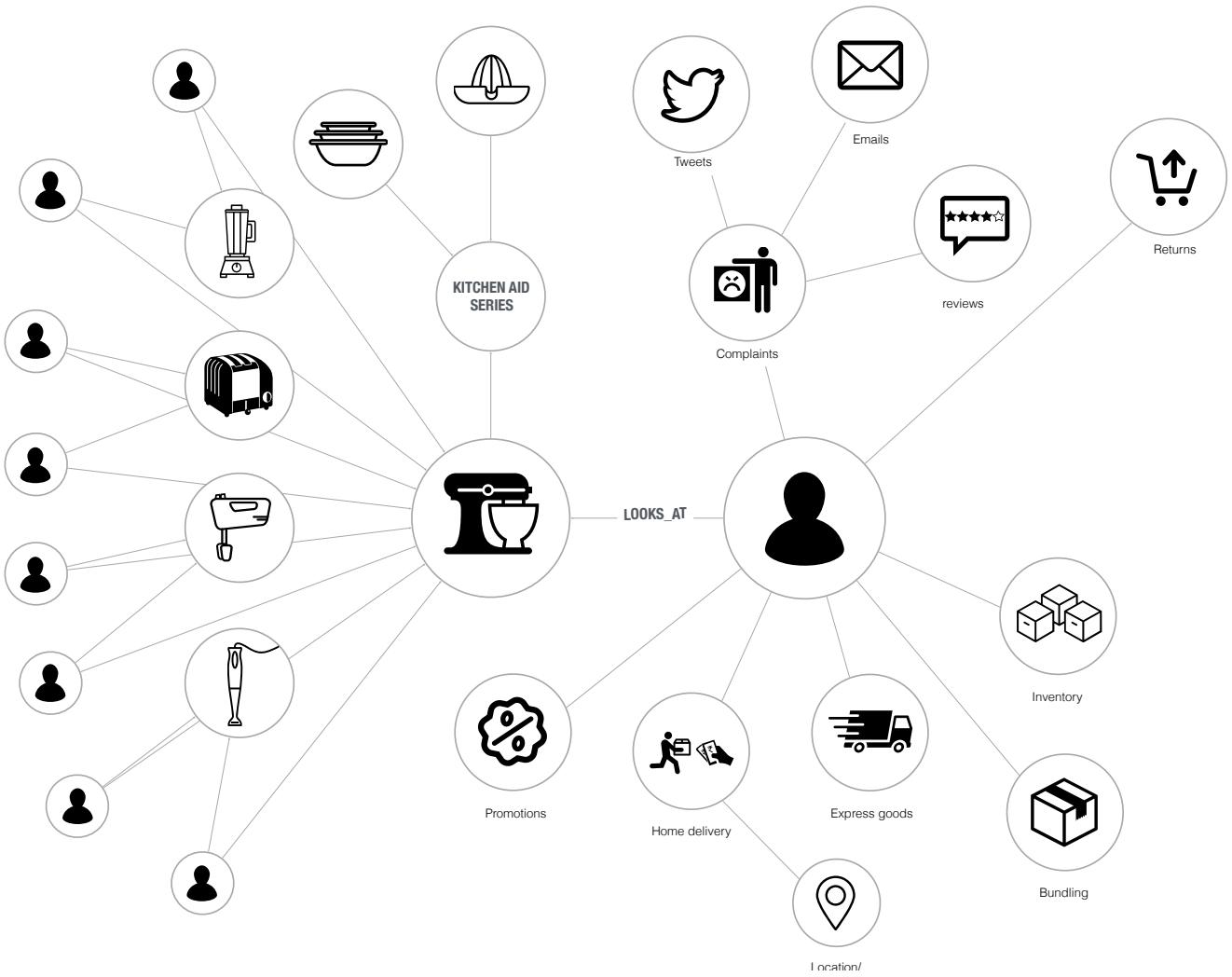
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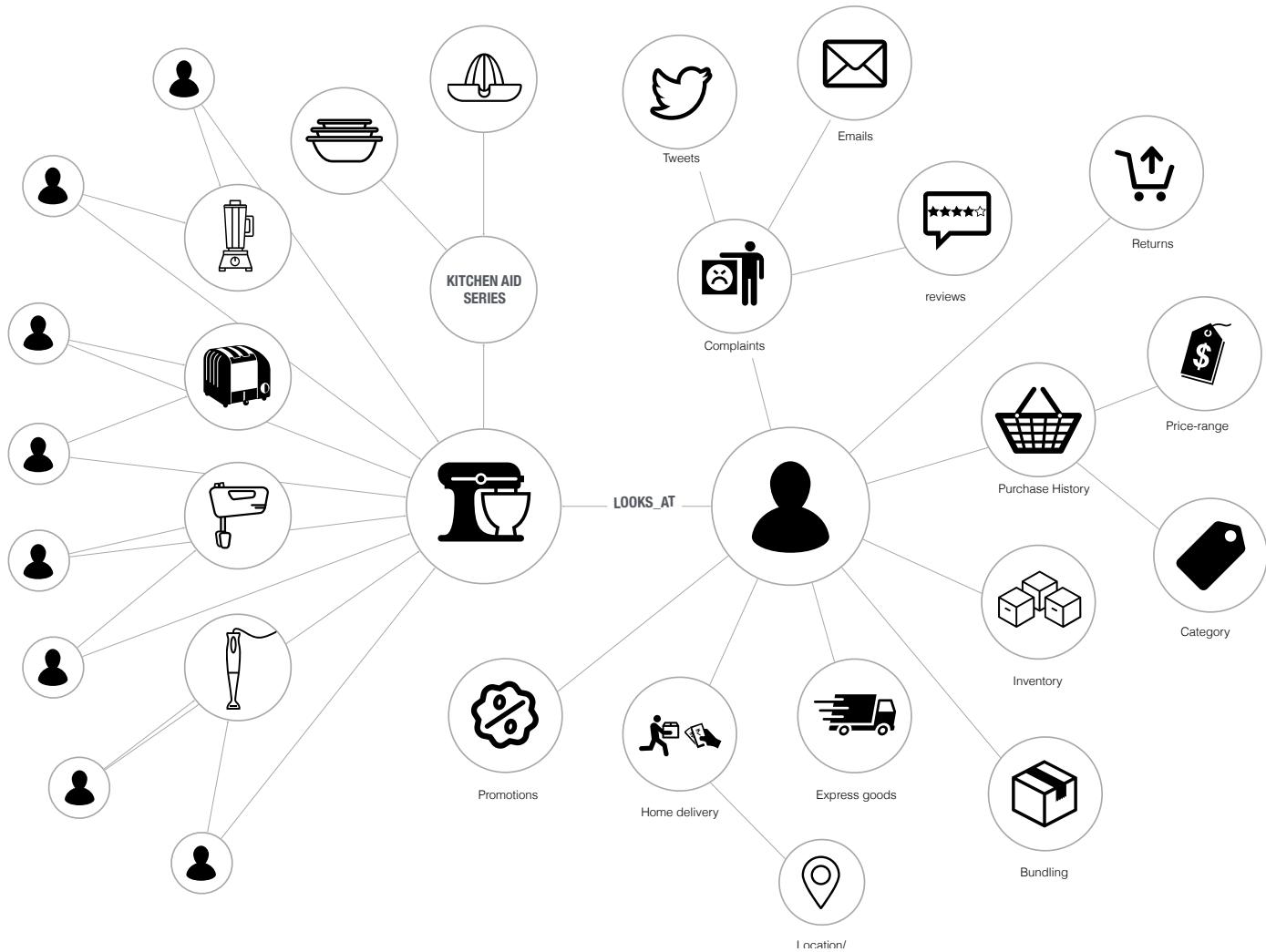
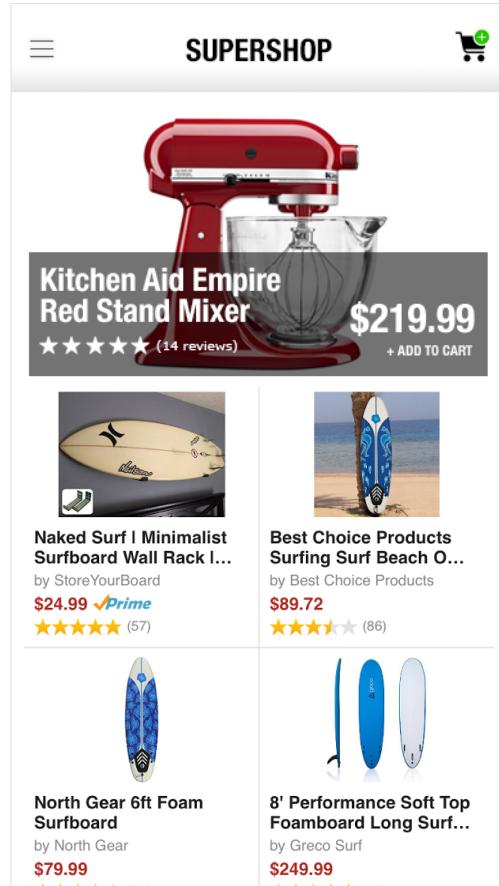


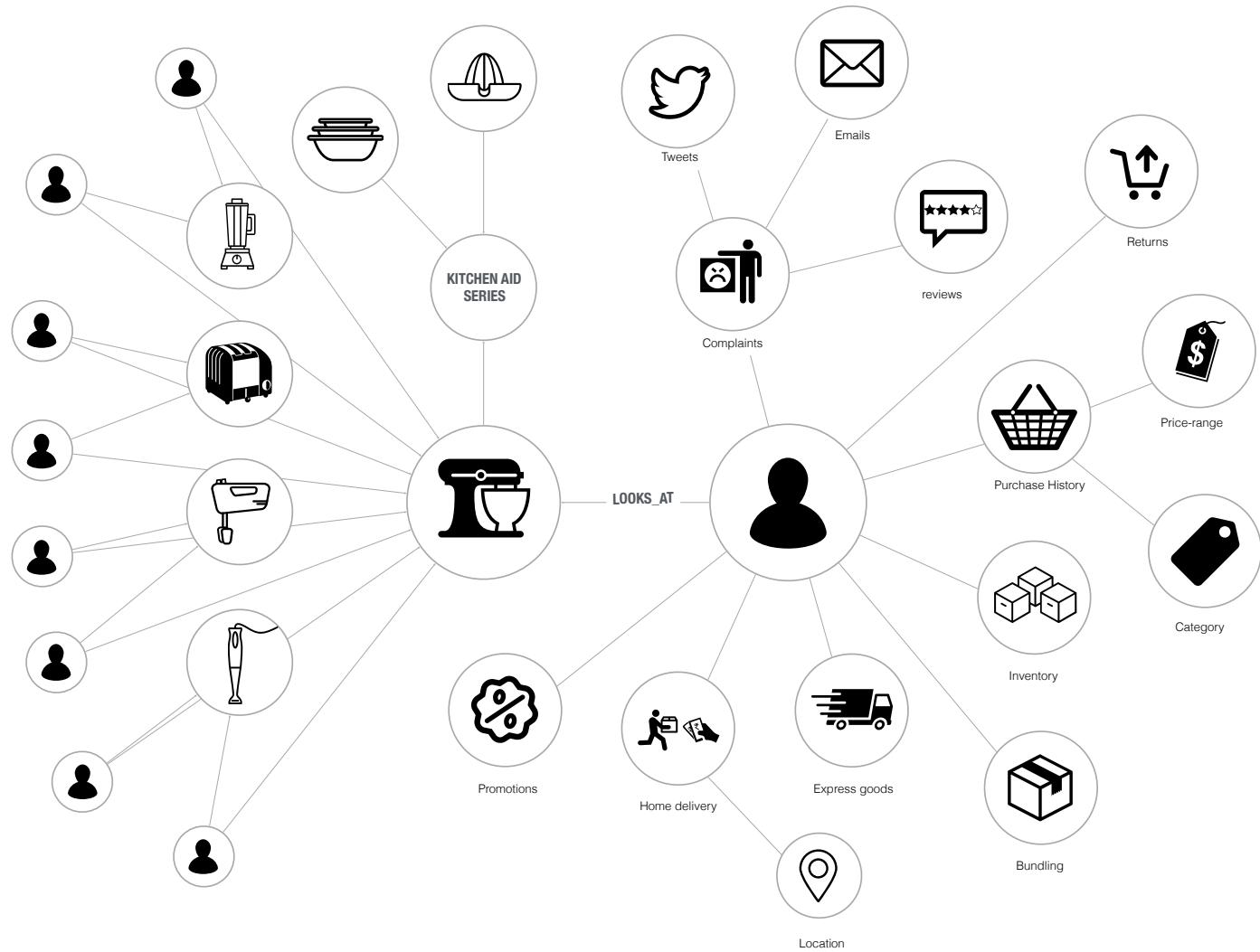
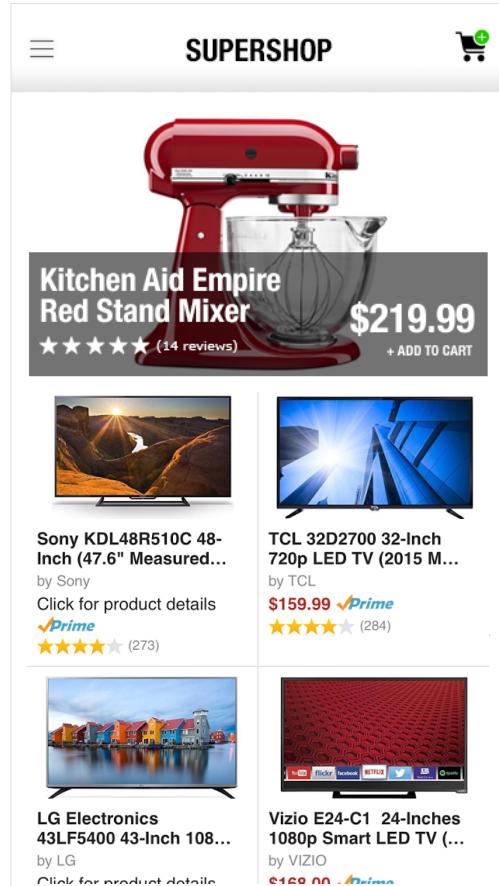
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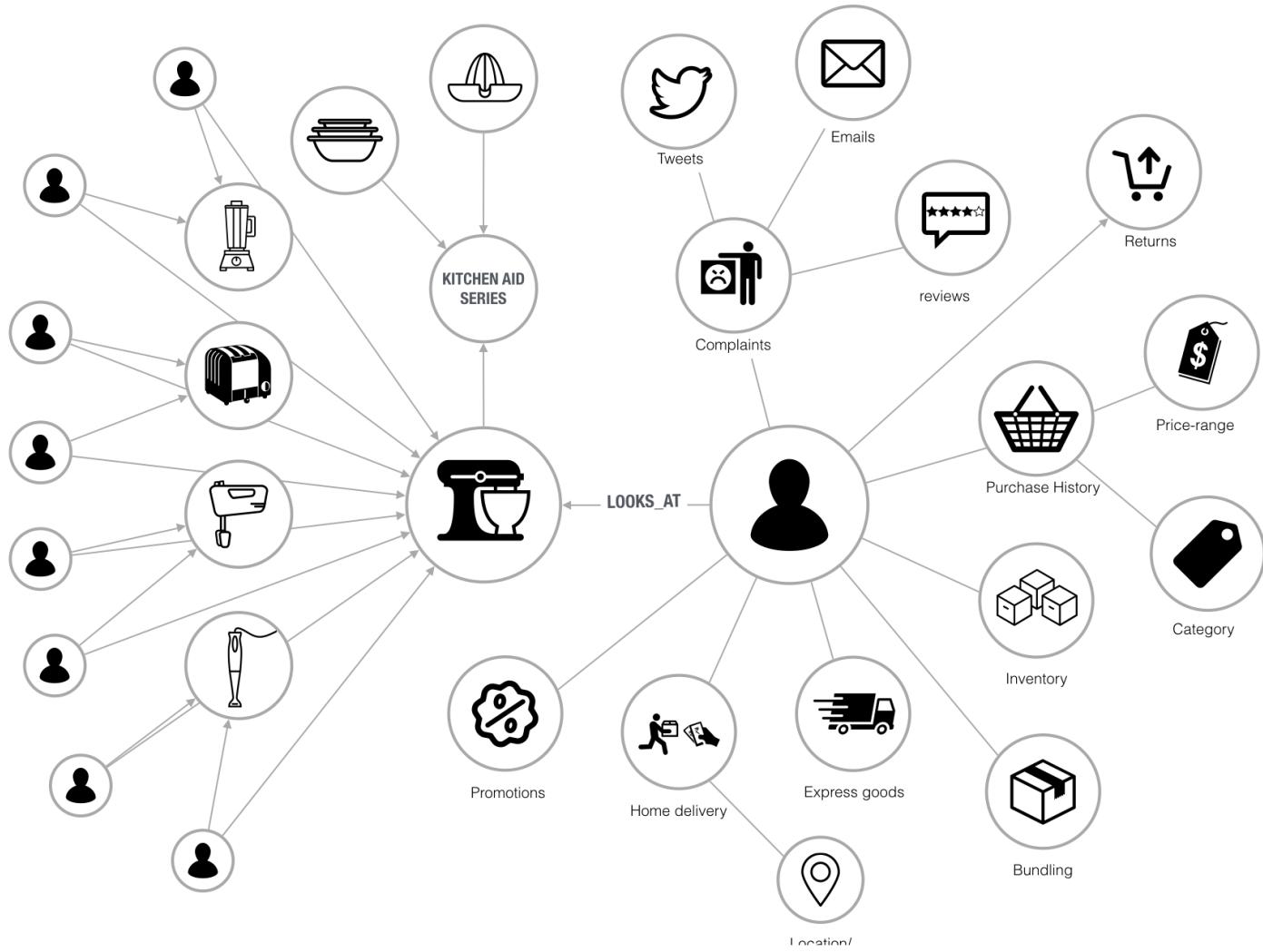
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# Simple Recommendations

# Content Filtering: Article Recommendations

```
1 MATCH (u:User)-[:LIKED]->(:URL)-[:IS_ABOUT]->(k:Keyword)
2 WHERE u.name = "lyonwj"
3 WITH k, count(*) AS num
4 RETURN k.text, num ORDER BY num DESC LIMIT 10
```

k.text	num
neo4j	3
montana	3
algorithm	2
businesses	2
data	2
owner	2
server	2
problem	2
database	2
web	2
Returned 10 rows in 24 ms.	

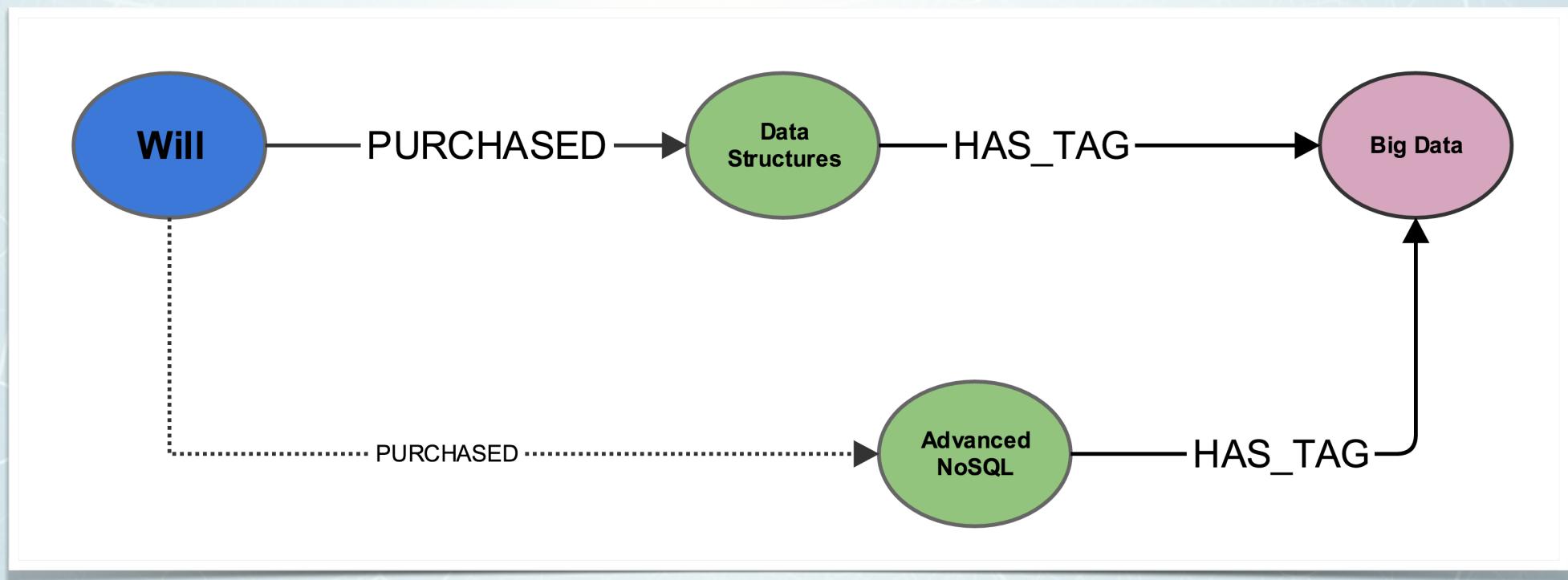
# Content Filtering: Article Recommendations

```
1 // Recommend articles
2 MATCH (u:User)-[:LIKED]->(article:URL)-[:IS_ABOUT]->(k:Keyword)
3 WHERE u.name = "lyonwj"
4 MATCH (k)<-[:IS_ABOUT]-(rec:URL) WHERE NOT (u)-[:LIKED]->(rec)
5 WITH rec, collect(DISTINCT k.text) AS keywords
6 RETURN rec.title, size(keywords) AS weight, keywords ORDER BY weight DESC LIMIT 10
```

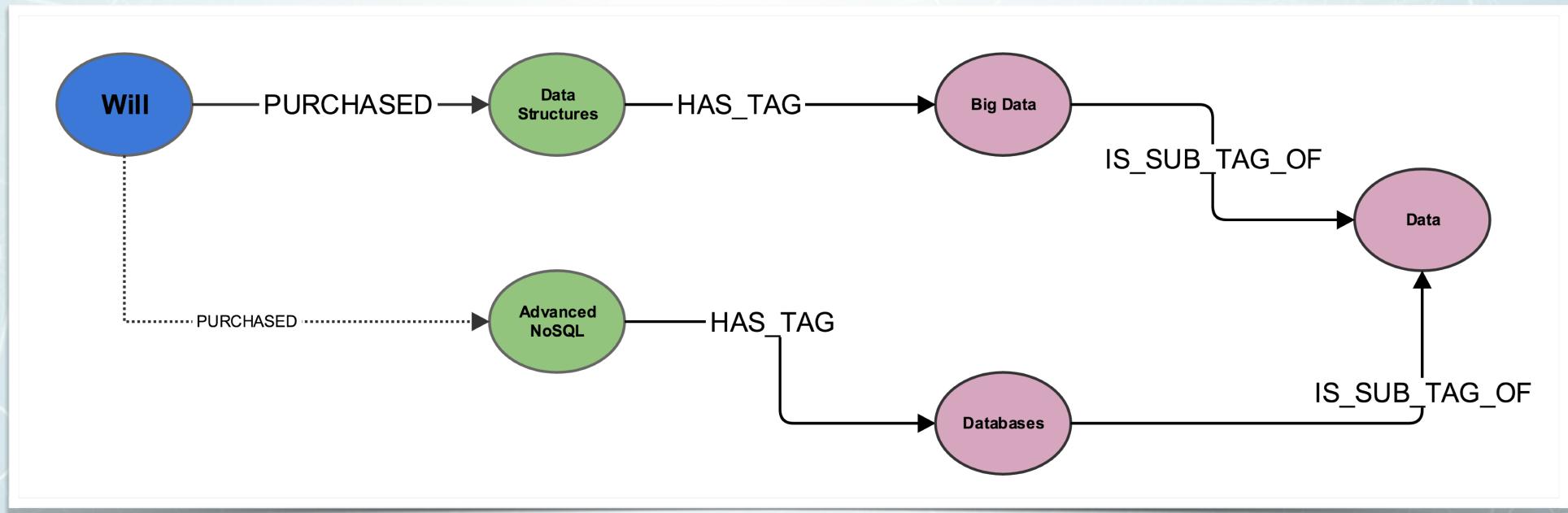
rec.title	weight	keywords
City of Missoula to seek court supervision of Mountain Water Co.	5	[water, problem, missoula, court, city]
A Visit to the Strange, Secretive World of David Bowie's 'Lazarus'	5	[mr, reading, script, main, world]
South Carolina governor to urge tolerance for immigrants in State of Union response	4	[state, response, presidential, south]
My first day at San Quentin State Prison — Medium	4	[state, medium, man, day]
Florida's Death Machine Loses Again	4	[state, court, machine, law]
Google self-driving cars would have caused 10 accidents in 2015 without test drivers taking control	4	[drivers, cars, 2015, system]
South Carolina governor to urge tolerance for immigrants in State of Union response	4	[state, response, presidential, south]
My first day at San Quentin State Prison — Medium	4	[state, medium, man, day]
Watch tonight: Obama gives his last State of the Union speech	3	[state, article, owner]
Political Prediction Market: Bernie Sanders (slowly) gains on Hillary Clinton	3	[winning, state, political]

Returned 10 rows in 23 ms.

# Content Filtering: Product Recommendations

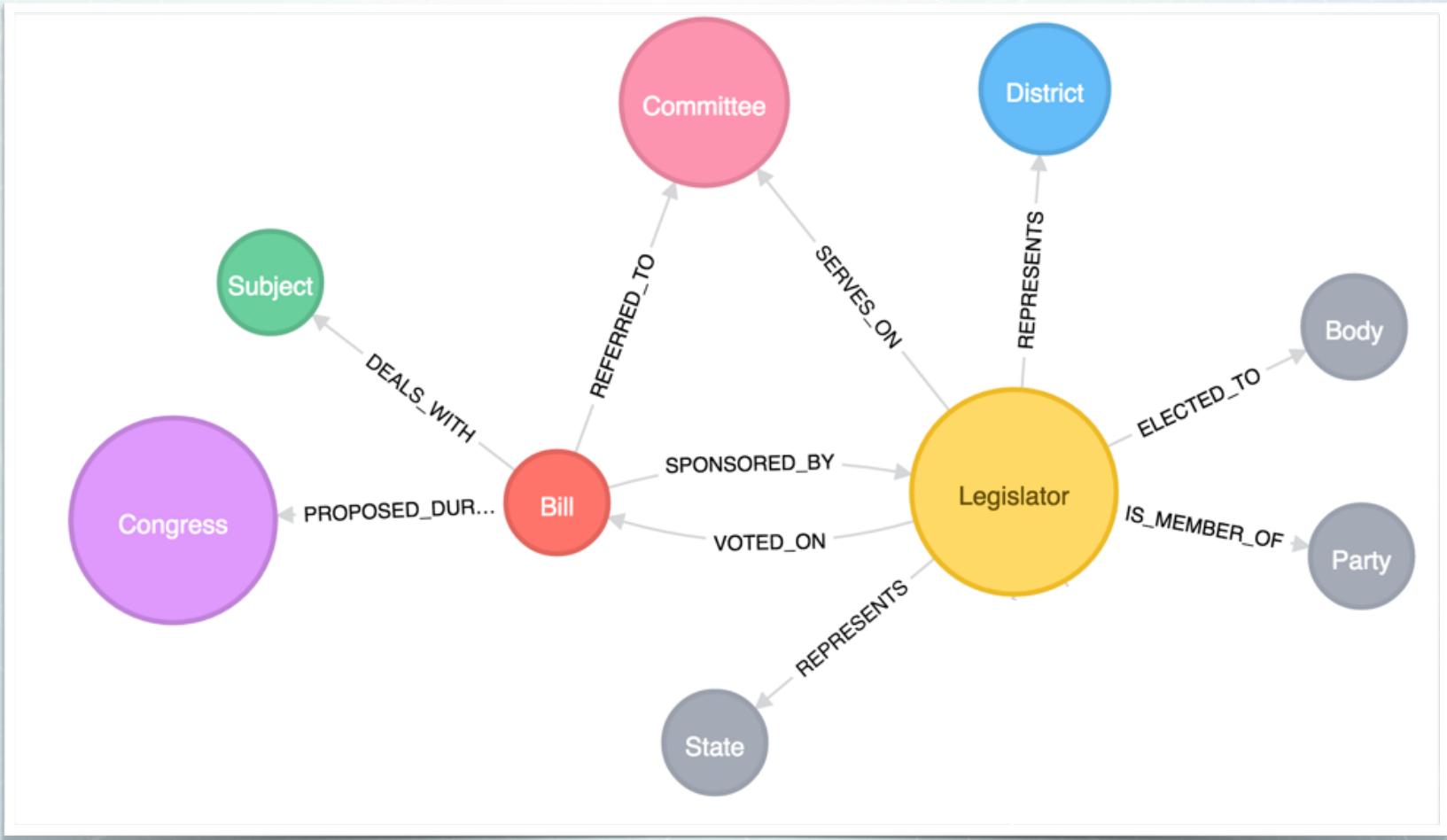


# Content Filtering: Product Recommendations

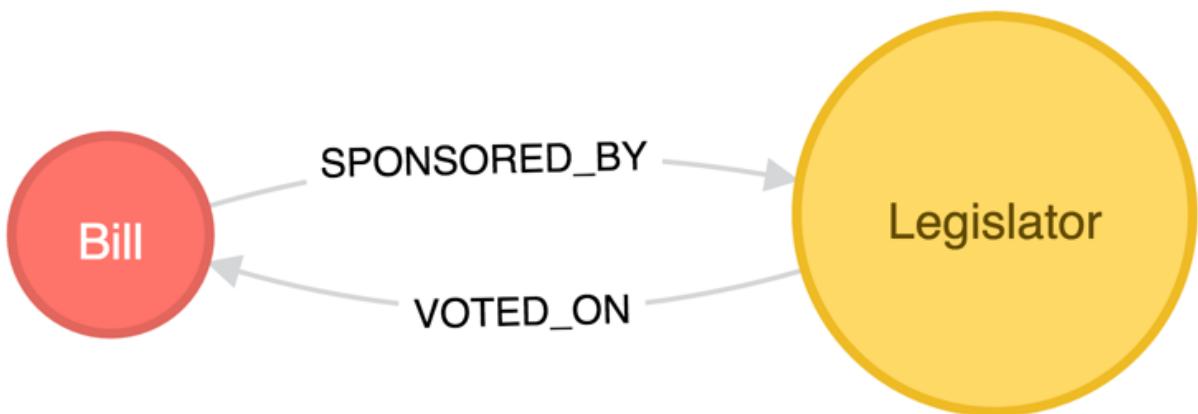


# **Our Patriotic Duty**

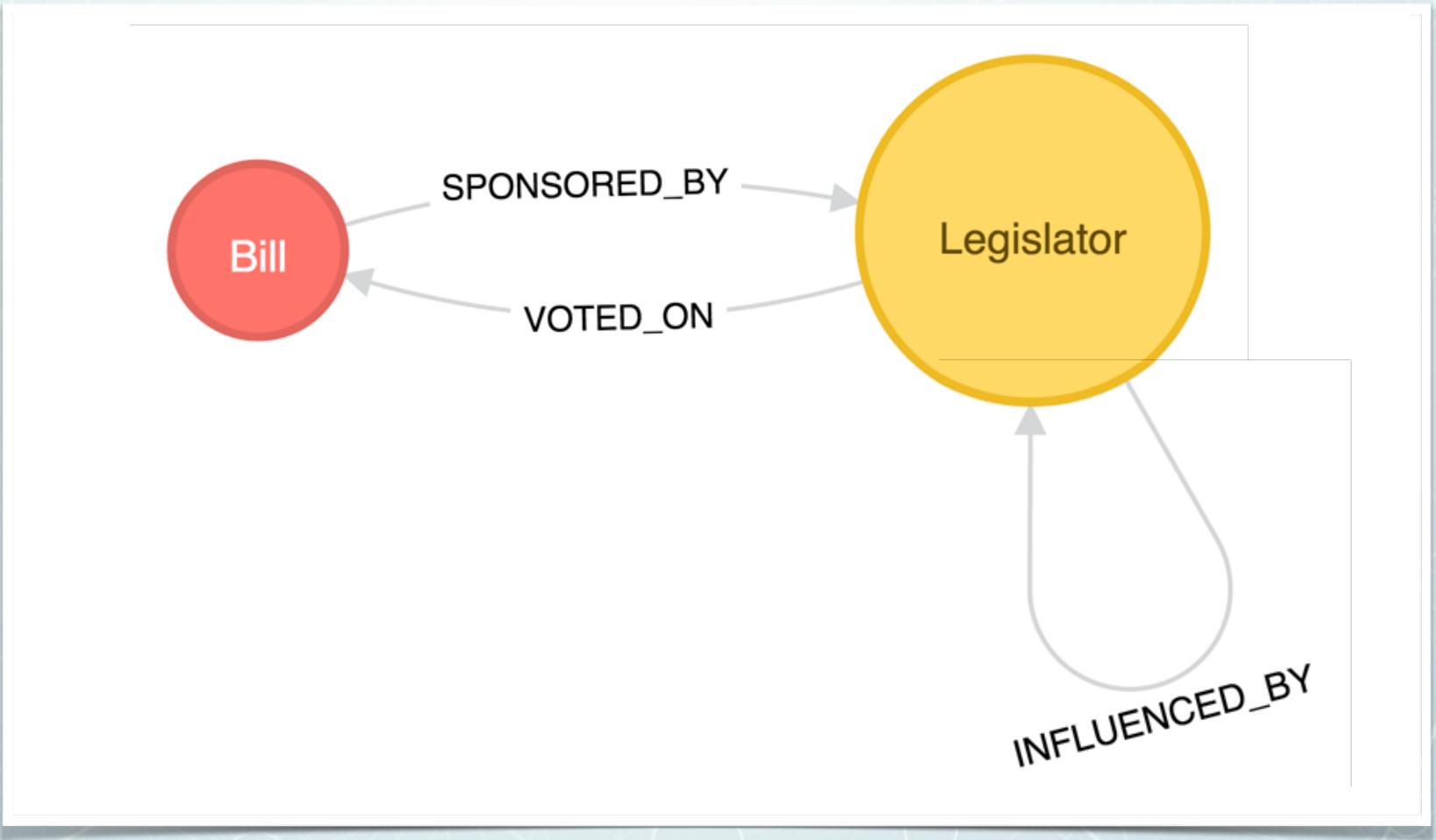
# Legislative Graph

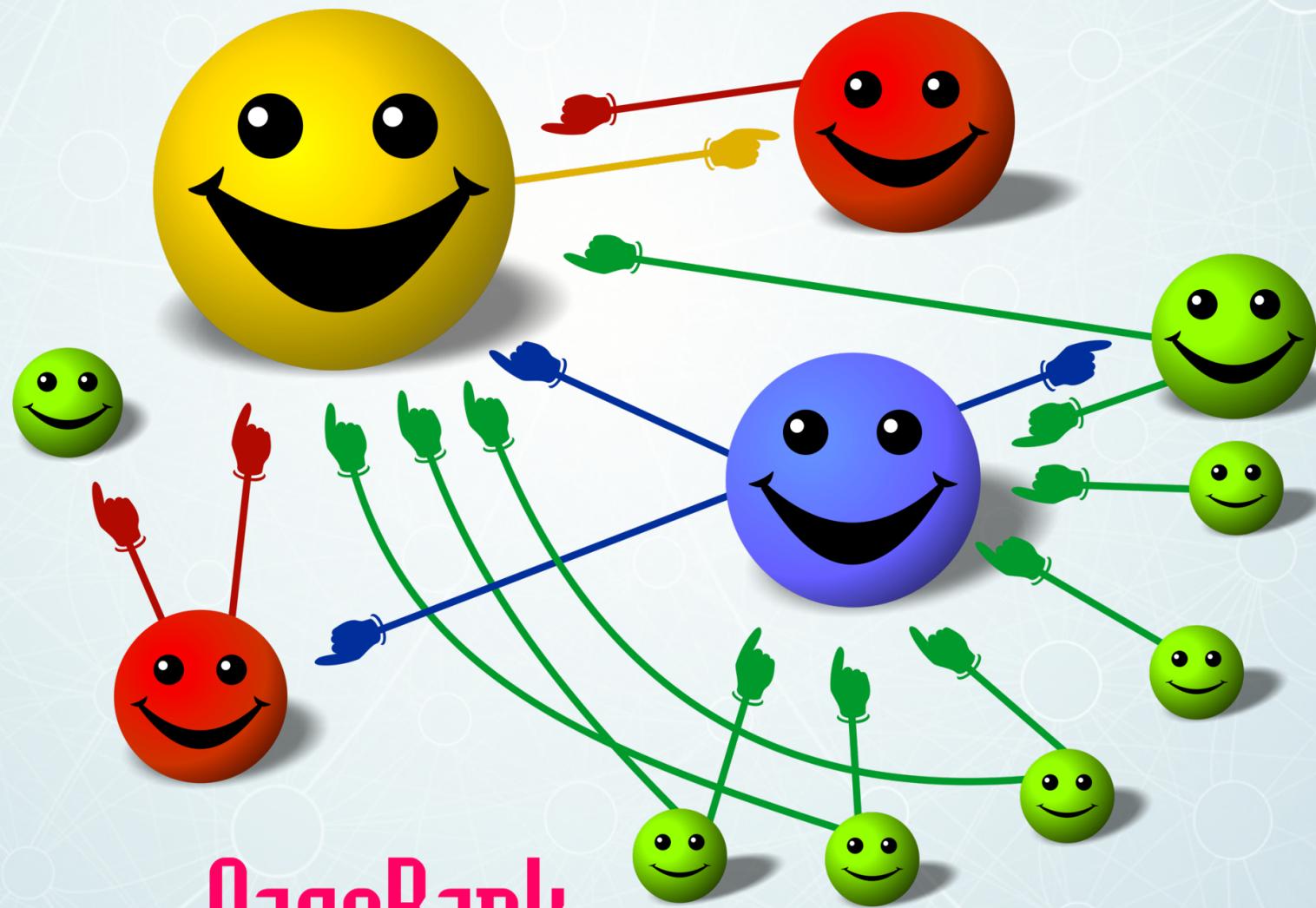


# Determining Influence



# Determining Influence





# PageRank

# Executing PageRank

```
1 MATCH (l:Legislator)
2 WITH collect(l) AS nodes
3 CALL apoc.algo.pageRankWithConfig(nodes,{types:'INFLUENCED_BY'}) YIELD
  node, score
4 SET node.pagerank = score
```



# Most Influential Senators

```
1 MATCH (l:Legislator) WHERE EXISTS(l.pageRank) WITH l, l.pageRank as pg
2 MATCH (l)-[:ELECTED_TO]->(b:Body {type: "Senate"})
3 RETURN l.firstName + l.lastName as name, pg ORDER BY pg DESC LIMIT 10;
```

\$ MATCH (l:Legislator) WHERE EXISTS(l.pageRank) WITH l, l.pageRank as pg MATCH (l)-[:ELECT...



Rows	name	pg
A	OrrinHatch	1.98969
Text	CharlesGrassley	1.78147
	BenjaminCardin	1.49014
	JohnThune	1.42174
Code	MikeLee	1.37878
	LamarAlexander	1.37011
	JerryMoran	1.34828
	JohnCornyn	1.32145
	JohnBarrasso	1.30451
	JeffFlake	1.27582
Returned 10 rows in 492 ms.		

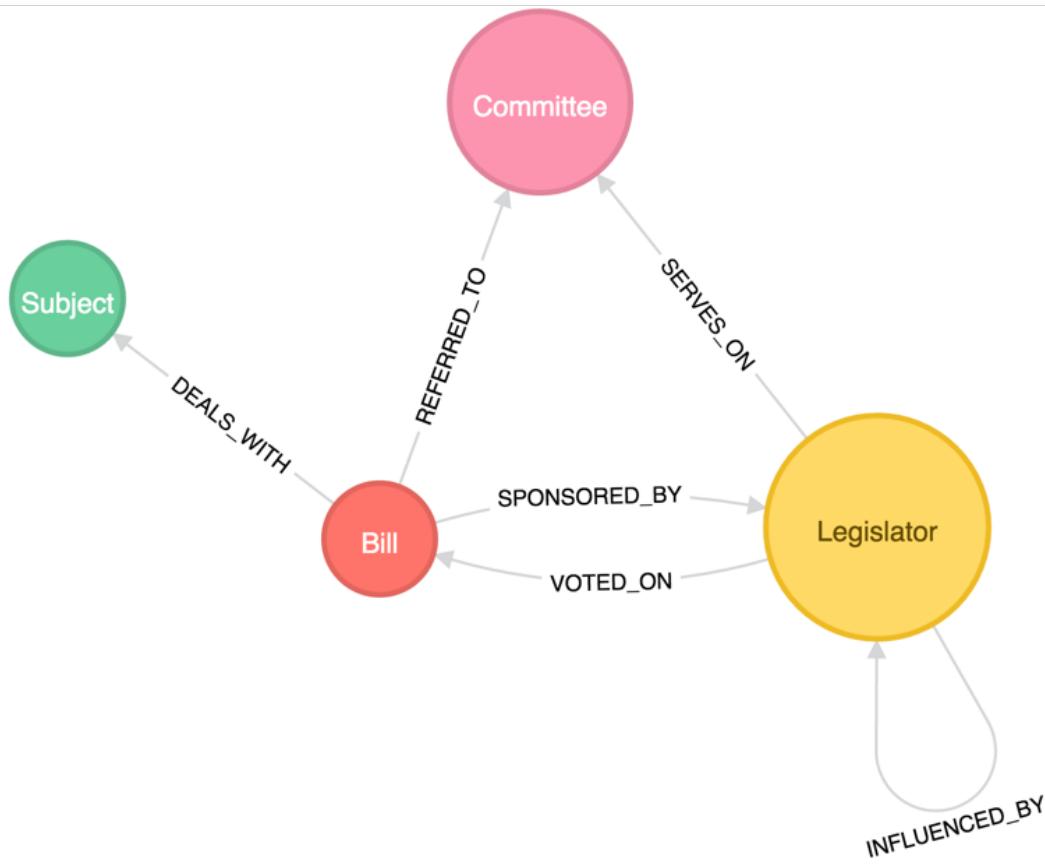
# Most Influential Representatives

name	pg
DianeBlack	1.45343
BrettGuthrie	1.21654
CarolynMaloney	1.21216
RosaDeLauro	1.17221
ErikPaulsen	1.11089
BobGoodlatte	1.07024
ChristopherSmith	0.99679
CharlesBoustany	0.98916
SamJohnson	0.95875
MatthewCartwright	0.85049

**Recommend to Me:**

**Member of Congress who can get ~~me~~ a Tesla  
everyone ^**

# Subject Matter Experts



# Combining Analytics + Subgraph Traversal

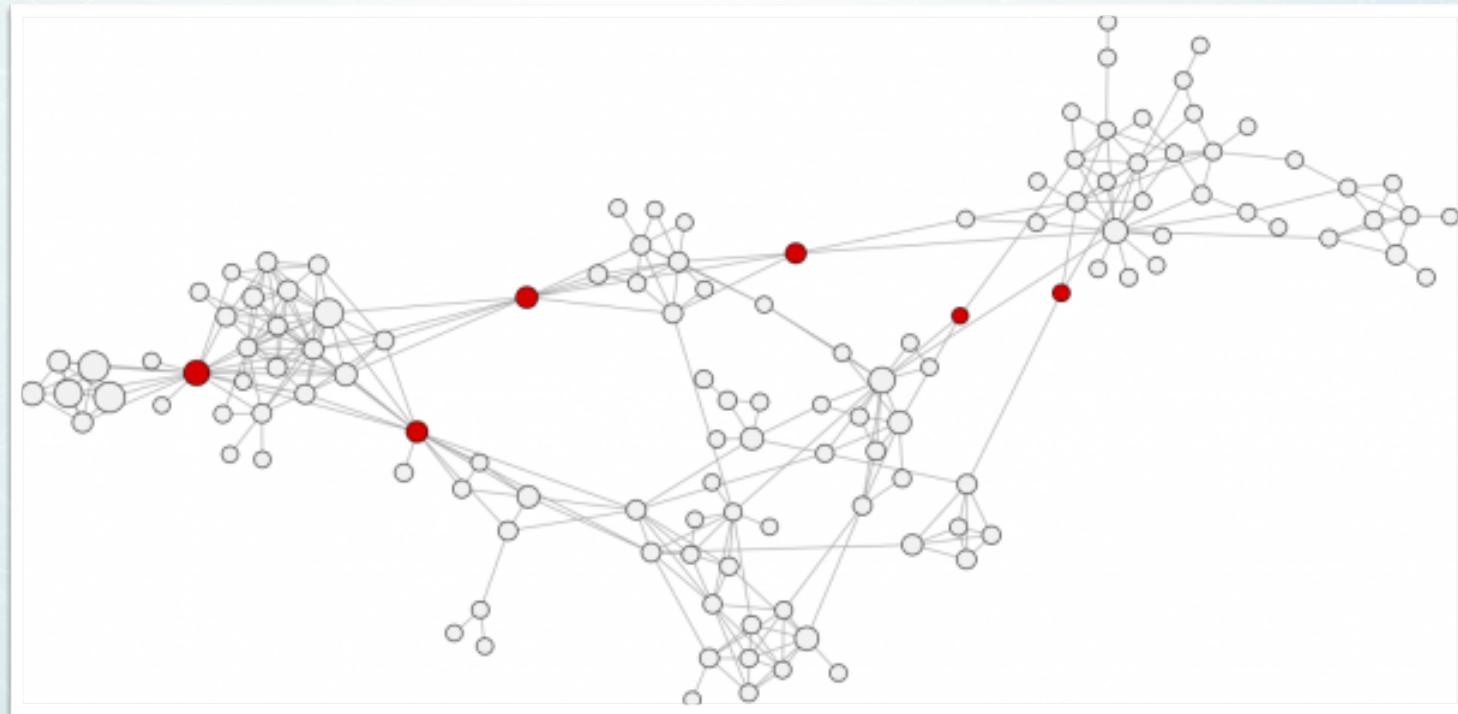
```
MATCH (l:Legislator) WHERE EXISTS(l.pageRank) WITH l, l.pageRank as pg
MATCH (l)-[r:SERVES_ON]->(c:Committee)
MATCH (c)<-[r:REFERRED_TO]-(b:Bill)-[d:DEALS_WITH]->(s:Subject)
WHERE s.title = "Hybrid, electric, and advanced technology vehicles"
MATCH (l)-[r:IS_MEMBER_OF]->(p:Party)
```

name	pg	committee	rank	party
Orrin Hatch	1.98969	Senate Committee on Finance	1	Republican
Charles Grassley	1.78147	Senate Committee on Finance	2	Republican
Benjamin Cardin	1.49014	Senate Committee on Environment and Public Works	3	Democrat
Benjamin Cardin	1.49014	Senate Committee on Finance	8	Democrat
Diane Black	1.45343	House Committee on Ways and Means	15	Republican
Diane Black	1.45343	House Committee on the Budget	6	Republican
John Thune	1.42174	Senate Committee on Finance	7	Republican
Mike Lee	1.37878	Senate Committee on Armed Services	12	Republican
Mike Lee	1.37878	Senate Committee on Energy and Natural Resources	4	Republican
Lamar Alexander	1.37011	Senate Committee on Energy and Natural Resources	11	Republican

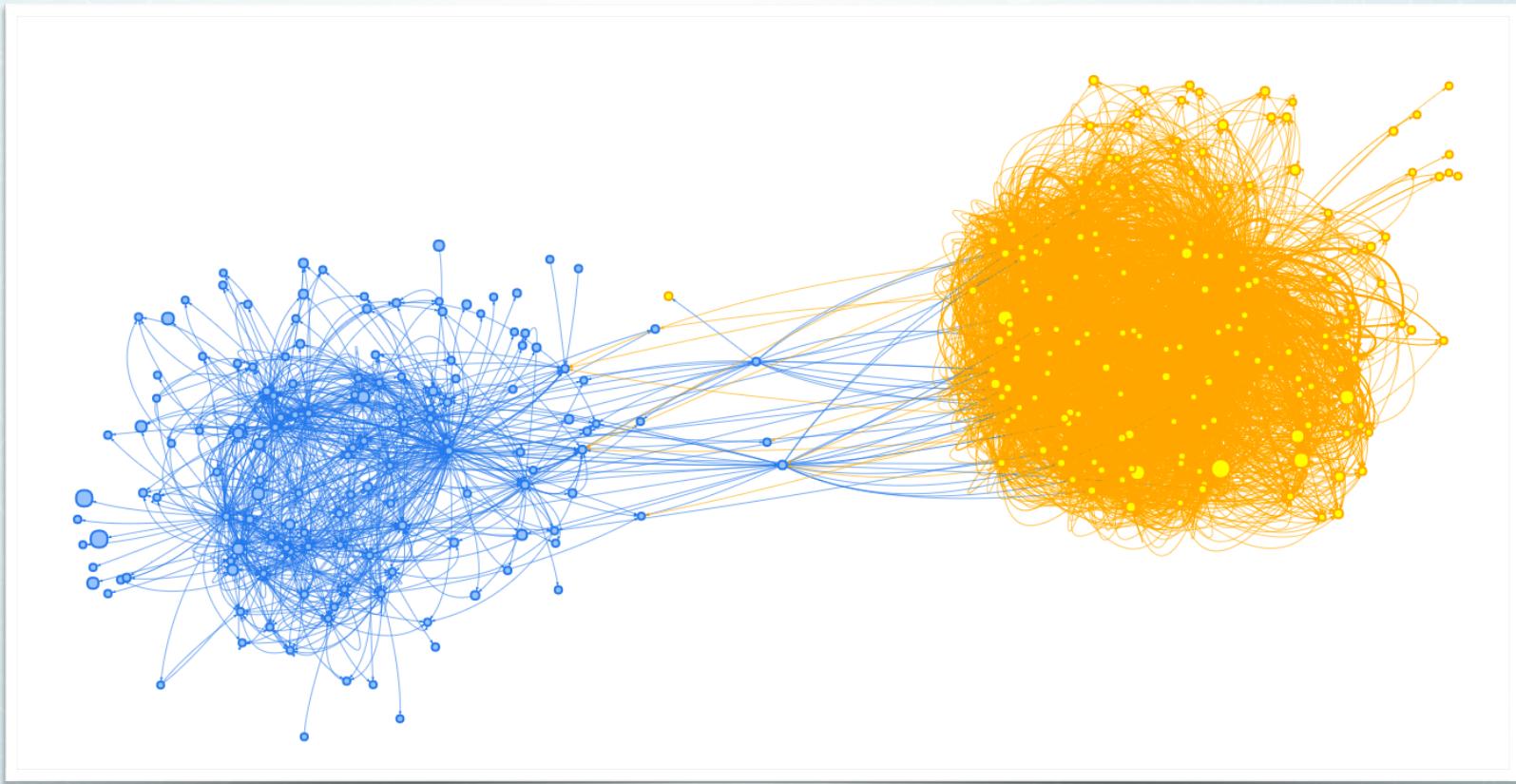
# Other Graph Algorithms

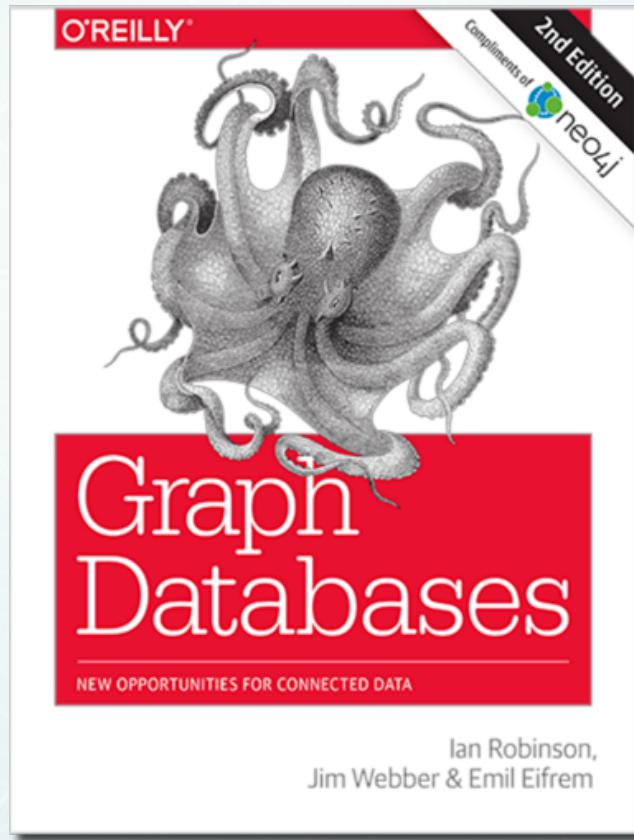
- **Community Detection**
- **Centrality (Betweenness, Closeness)**
- **aStar (djikstra with  $h(0)$ )**

# Betweenness Centrality



# Community Detection





**graphdatabases.com**

# THANK YOU!



**Ryan Boyd**  
@ryguyrg    [ryan@neo4j.com](mailto:ryan@neo4j.com)